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MANAGEMENT SYSTEM AND METHOD FOR SERVICE SUBSCRIPTION PROVISIONING

FIELD OF THE INVENTION

[0001] The present invention relates to subscription management in communication networks and, more specifically, to the provision of a generic interface suitable for service provisioning mechanisms.

BACKGROUND

[0002] The provisioning process is typically carried out by a number of resources interfacing to each other in such a manner that a provisioning entity issues the appropriate orders to a number of provisioned entities in order to initiate a subscription where a subscriber settles a contractual agreement with a service provider regarding a provided service. The subscriber is thus allowed to subscribe to and withdraw from services as well as to register a number of users authorized to use such services, and to adapt certain user preferences or settings. The provisioning process as such is functionally independent from the service operation.

[0003] The constant evolution of products and platforms makes the communication networks become more complex, with more network nodes and with more interfaces appearing between network nodes, in addition to the currently existing interfaces between said network nodes. For instance, suitable interfaces for use during provisioning process go from the legacy of proprietary Command Line Interface (CLI), such as a so-called Man-Machine Language (MML) and a Common Administration Interface (CAI), to newer

and widely known industry or internet standards such as the Common Object Request Broker Architecture (CORBA), the Lightweight Directory Access Protocol (LDAP), Java or Web Services.

[0004] The number of different interfaces suitable for provisioning is expected then to continue growing, due to a lack of well-defined, and agreed-on, set of principles and conventions to encourage the appearance of convergent solutions for a standard provisioning mechanism. This makes the task of supplying an integrated service provisioning an increasingly difficult, time-consuming, and expensive problem.

[0005] Therefore, a primary object of the present invention is the provision of a generic solution for provisioning services, fitting any domain and for any services, allowing potential users of a service to be subscribed to and withdrawn from the service, as well as to provide preferences and settings for the service operation.

RELATED ART

[0006] An interesting starting point for approaching the objects of the present invention is the International publication WO 00/38437. This patent application proposes a subscription handler interface between a Customer Administrative System (CAS) and database network elements of a communication network. This interface includes a database for storing network over-view knowledge in the form of a network model, and a subscription handler service agent in communication with said database network elements. The subscription handler service agent is responsive to the issued order for storing the order in the database as network over-view knowledge concerning the subscriptions

maintained in the database network elements. In particular, this agent receives orders originated by the Customer Administrative System, consults databases storing information about the network nodes where the service related information is maintained, acts over the corresponding network elements, and also evaluates whether or not the received orders are coherent.

[0007] Solutions like the above subscription handler agent are, however, too specific and particularly applicable for a given point in the network, namely between a CAS and a Mediation Device network node, the latter intended for controlling the provisioning transactions. That is, there is a need to mediate between the provisioning and the provisioned entities. In this respect, the invention is intended to be applied between a CAS and any particular mediation device arranged for mediating between the interface supported by CAS and the specific protocol that a particular node supports for being provisioned.

[0008] Thus, the above subscription handler agent is not well suited in scenarios where extra network nodes are not desired, or wherein the existing network architecture does not comply with the particular provisioning architecture proposed by this related art application, which is intended for a CAS communicating with a plurality of database network elements, each database network element having its own interface.

[0009] Further, US patent application publication US 2002/0013827 describes a Personal Service Environment Manager (PSEM) for managing information related to end-users of a communication network. This Personal Service Environment Manager includes functions for providing and managing service data, end-user profile data, and end-user service profile data, shared among applications servers and

user groups. Relevant aspects of said PSEM are its interfaces to other entities and functions, its distinguishing between user profile data and service-related data, the latter in terms of service profile data and service data, and its further distinguishing between service profile data and service data.

[0010] This Personal Service Environment Manager is only applicable in the Service Network, and it is attached to a particular protocol, namely a Lightweight Directory Access Protocol (LDAP). This solution, while enough to accomplish its purpose, becomes quite restrictive and hardly applicable when the intention is to provide a solution covering all network parts that likely include several network domains, applying to different nodes that manage multiple varieties of protocols, and thus harmonising a common provisioning mechanism.

[0011] A still further teaching in respect of management of user-service relationships is found in the European patent publication EP 1 128 695. This teaching proposes a Telecommunication system for managing user-service relationships and the corresponding software. The system comprises a memory for storing user signals defining users and for storing service signals defining user-service relationships. More particularly, the system defines three kinds of signals representing, users, services and user-service relationships.

[0012] The teaching behind this application is, however, strongly oriented to user-service relationships whereas a complete interface solution applying to different provisioning and provisioned network entities is not sufficiently disclosed. Thus, the invention does not seem to be directly applicable for networks including several network domains wherein service data may be more

significantly linked to subscribers than to users in a particular domain. Moreover, this application rather seems to apply for local establishment of appropriate relationships between user and service data than to manage a generic provisioning mechanism applying to different nodes with a variety of protocols, and thus harmonising with a common provisioning mechanism.

[0013] The solutions in the above applications as well as other currently existing mechanisms for provisioning of services still present quite significant drawbacks for approaching a generic mechanism that is not essentially coupled with a particular technology, a particular data modelling, or a particular Operation and Maintenance system.

[0014] That is, quite a few existing solutions are based on a tight-coupling with a particular technology like, for example, Java or CORBA or LDAP. This technology coupling assumes the need for supporting a given technology for the communications protocol and/or the data modelling language in both parts of the provisioning interface. Nevertheless, forcing a specific technology is not always an acceptable solution.

[0015] In addition to the technology coupling, there is also a quite extended trend to provide solutions where the coupling is addressed to an applicable data model. In this respect, existing interfaces have strong dependencies with the data models of the services being provisioned, making such provision complex to extend and to improve. A typical example of this data model coupling is how embedded the data model is within the commands on proprietary Command Line Interfaces (CLI) for provisioning.

[0016] Apart from the above couplings, there are other provisioning mechanisms deeply integrated with Operation and Maintenance (O&M) systems, thus making it difficult to understand as well as limiting the functionality which an adaptable O&M system is expected to achieve for as many domains as possible.

[0017] Last, but not least, is that most of the currently existing interfaces operating in known provisioning mechanisms are based on obsolete or proprietary technologies. Such proprietary interfaces cannot be easily found outside vendor-specific networks, which limits the universality of the interface, and makes it less attractive and useful. By way of contrast, there are also some trends that, even though they can fit the provisioning problem domain, still offer a quite theoretical approach and lack the definition of meaningful operations and objects specific to a generic but applicable provisioning mechanism.

[0018] Currently, the 3rd Generation Partnership Project (3GPP) has introduced the concept of an Integration Reference Point (hereinafter IRP) for Operation and Maintenance (O&M) interfaces as described in 3GPP TS 32.102. Virtually all types of telecom and datacom networks comprise many different technologies purchased from several different vendors. This implies that the corresponding management solutions need to be built by integrating product-specific applications from different vendors with a number of generic applications, each generic application providing some aspect of multi-vendor or multi-technology support.

[0019] When providing integrated management solutions for multi-vendor networks, there is a strong requirement under 3GPP scope that the Network Elements and its corresponding

management solutions are arranged for being integrated into other systems. In this context, a Network Element (NE) is a discrete telecommunications entity, which can be managed over a specific interface. Thus, telecom vendors are strongly impelled to provide a set of network infrastructure IRPs to ensure interoperability. These IRPs might be provided by an NE, or an Element Manager (EM), or a Network Manager (NM), or a Sub-Network Manager (SNM). In the same context, a Network Manager (NM) provides a package of end-user functions for management of a network, as to some extent supported by an EM, but it may also involve direct access to the NE. Also in the same context, a Sub-Network Manager (SNM) includes functions that are related to a network model for a set of Network Elements constituting a clearly defined sub-network. This model enables additional functions on the sub-network level such as, typically, in the areas of network topology presentation, alarm correlation, and service impact analysis.

[0020] These IRPs are described by a common Naming Convention specification. In this respect, the Unified Modelling Language (UML) notation is used in 3GPP to describe with abstract classes, which are called Managed Object Classes (hereinafter MOC), the containment and naming relationships among the different network entities and equipment. In accordance with the technical specification from 3GPP TS 32.300 "Name Convention for Managed Objects", wherein a name space is a collection of names, the name convention makes use of a hierarchical containment structure, including its simplest one-level form, the so-called flat name space. This name convention does not support an arbitrarily connected name space, or graph structure, in which a named object can be both child and parent of another named object. A containment

relationship may describe, for instance, a network signalling card as "contained" in the network element which it is physically plugged into. This type of relationships is also known as naming, because it describes the way to name or locate an instance of any Managed Object Class within a data model, following a hierarchical path of parent and child objects. Generally speaking and for the purpose of the present invention, the term "objects" refer to instances of Object Classes.

[0021] Nowadays the Integration Reference Points (IRPs) already defined by 3GPP cover three O&M areas: Configuration Management, Fault Management and Performance Management.

[0022] Despite the current trends of using solutions based on a mediation between a provisioning entity and a number of provisioned entities, the mediation arranged for handling one protocol suitable for the provisioning entity and as many different protocols as required by the different provisioned entities, none of the above related art item provides for a solution applicable to different provisioning and provisioned entities, and combinations thereof, in networks of different types that likely include several domains, such solution not essentially coupled with a particular technology, with a particular data modelling embedded in the specific protocol or technology used, or with a particular O&M system.

[0023] It is therefore an object of the present invention to provide a solution applicable to all network domains and interfaces, thus applying to different nodes that likely manage a variety of protocols and data models, and thus harmonising with a common provisioning mechanism.

[0024] More specifically, it is an object of the present invention to find a solution for a common provisioning mechanism that may be applied to every point in a network topology where there is a provisioning communication.

[0025] It is a further object of the present invention to provide a solution where a Subscription Management is carried out in such a manner that a resulting data model and operations are simple and universal, and support different degrees of complexity for services at diverse provisioned nodes.

[0026] It is a still further object of the present invention to provide a Subscription Management that, accomplishing the above objects, harmonizes with the concept of Integration Reference Point (IRP) introduced by 3GPP, within a so-called IRP Generic Network Resource Model, for the O&M areas: Configuration Management, Fault Management and Performance Management.

SUMMARY OF THE INVENTION

[0027] The above objects, among others, are accomplished in accordance with the invention by the provision of a management system, method and means for provisioning services to subscribers of a communication network.

[0028] The management system comprising a Management Entity that has a Provisioning Node side intended for provisioning a service, and a number of Managed Entities each one having a Provisioned Node side intended for receiving provisioning orders from the Management Entity.

[0029] The Provisioning Node side and the number of Provisioned Node sides in this management system support a Subscription Management Generic Interface (SuM-GI) that

includes a SuM-GI Data Model and a number of SuM-GI Operations for managing the Objects Classes in said SuM-GI Data Model.

[0030] The Provisioning Node side comprises a SuM-GI Manager for managing subscriptions to services in any Managed Entity by operating on Objects Classes included in the SuM-GI Data Model, and a number of Protocol Adapters for communicating with specific protocol technologies used at each Managed Entity.

[0031] The Provisioned Node side comprises a SuM-GI Agent for receiving provisioning orders operating on Object Classes included in the SuM-GI Data Model, and at least one Protocol Adapter for communicating with a particular protocol technology used by the SuM-GI Manager to send provisioning orders.

[0032] Thus, at least one Managed Entity in this management system is a Network Element in which a given service is provisioned. Each Network Element has its own internal data model and further comprises a Mapping Module for mapping objects in the SuM-GI Data Model received from a Provisioning Node side to said own internal data model.

[0033] Also in this management system, a number of Managed Entities may optionally form a hierarchical Sub-Network Manager structure interposed between a centralized Management Entity, namely a Network Manager, and a number of Network Elements. Each Sub-Network Manager further comprises a Provisioning Node side toward a Managed Entity, this Managed Entity being a Network Element or another Sub-Network Manager.

[0034] In other words, each Sub-Network Manager comprises a SuM-GI Manager, a SuM-GI Agent and a number of Protocol

Adapters, thus presenting a Provisioned Node side towards a Provisioning Node side at a Network Manager or at another Sub-Network Manager, and a Provisioning Node Side towards a Provisioned Node side at a Network Element or at another Sub-Network Manager.

[0035] In particular, a Subscription Management Generic Interface (SuM-GI) Manager at a Provisioning Node side and a SuM-GI Agent at a Provisioned Node side comprise means for mutual assignation of a specific protocol technology for communicating with each other.

[0036] A method is also provided by the present invention for provisioning services to subscribers of a communication network. The method applies between a Management Entity that has a Provisioning Node side intended for provisioning a service, and a number of Managed Entities each one having a Provisioned Node side intended for receiving provisioning orders from the Management Entity.

[0037] The method comprises the steps of:

- assigning a specific protocol technology for communication between a Subscription Management Generic Interface (SuM-GI) Manager at a Provisioning Node side and each SuM-GI Agent at respective Provisioned Node sides;

- sending provisioning orders from a SuM-GI Manager toward at least one SuM-GI Agent with a number of SuM-GI Operations intended for operating on Object Classes included in a SuM-GI Data Model; and

- determining at a SuM-GI Agent, upon receipt of a provisioning order from a SuM-GI Manager, whether current node is a Network Element (NE) where the

service is provisioned or there is at least one lower hierarchical Managed Entity, namely a Sub-Network Manager or a Network Element, where the provisioning order must be submitted.

[0038] Next, upon receipt of a provisioning order from a Subscription Management Generic Interface (SuM-GI) Manager in a SuM-GI Agent at a Sub-Network Manager, the method further comprises the steps of:

- transferring the provisioning order received from a first SuM-GI Manager at a Provisioning Node side of a Management Entity or higher hierarchical Managed Entity toward a second SuM-GI Manager at a Provisioning Node side of the current node;

- assigning a specific protocol technology for communication between the second SuM-GI Manager at the Provisioning Node side of the current node and each SuM-GI Agent at respective Provisioned Node sides of lower hierarchical Managed Entities; and

- sending provisioning orders from the second SuM-GI Manager toward at least one SuM-GI Agent at a Provisioned Node side of a lower hierarchical Managed Entity with a number of SuM-GI Operations intended for operating on Object Classes included in a SuM-GI Data Model.

[0039] Moreover, upon receipt of a provisioning order from a Subscription Management Generic Interface (SuM-GI) Manager in a SuM-GI Agent at a Network Element, the method further comprises the steps of:

- mapping the provisioning order received from a SuM-GI Manager at a Provisioning Node side with a number of

SuM-GI Operations intended for operating on Object Classes included in a SuM-GI Data Model into a number of internal operations intended for operating on an internal data model supported by the current Network Element; and

- acting on the internal data model with the mapped internal operation in order to carry out the provisioning order received from a SuM-GI Manager at a Provisioning Node side.

[0040] Furthermore, upon receipt of a provisioning order from a Subscription Management Generic Interface (SuM-GI) Manager in a SuM-GI Agent at a Network Element for which resulting data is expected, the method further comprises the steps of:

- mapping the resulting data from an internal data model into appropriate parameters of a number of SuM-GI Operations intended for operating on Object Classes included in a SuM-GI Data Model; and

- returning provisioning order results from the SuM-GI agent toward the SuM-GI Manager at a Provisioning Node side of a Management Entity or higher hierarchical Managed Entity with appropriate parameters in a number of SuM-GI Operations intended for operating on Object Classes included in a SuM-GI Data Model.

[0041] An important feature of the present invention is the provision of a Subscription Management Generic Interface (SuM-GI) that includes a SuM-GI Data Model and SuM-GI Operations intended to act on object classes of said SuM-GI Data Model.

[0042] The SuM-GI Data Model comprises any Managed Object Class, or combinations thereof, selected from a group of Object Classes that includes:

- Subscription object class, intended for modeling the agreement or contract established between a subscriber and a service provider and arranged for containing all the information related with the subscription;

- Subscriber object class, intended for identifying a subscriber holding a subscription with a service provider for a given service and arranged for registering a number of users allowed to use said given service;

- ProvidedService object class, intended for modeling a service provider inventory of offered services and arranged for maintaining applicable capabilities of said offered services;

- User object class, intended for identifying a user associated to a given subscriber and arranged for customizing particular user preferences for a given service; and

- UserServicePreferences object class, intended for allowing a number of users associated with a subscriber to have particular service preferences and arranged for containing different service capabilities enabled for each user.

[0043] The SuM-GI Operations comprise any Operations, or combinations thereof, selected from groups of operations that include:

- creating, modifying, removing and getting Subscriber;
- creating, modifying, removing and getting User;
- creating, modifying, removing and getting Provided Service.
- creating, modifying, removing and getting Subscription;
- adding, removing and getting User to or from a given Subscription;
- setting and getting User Service Preferences for a user under a given Subscription; and

[0044] The Subscription Management Generic Interface (SuM-GI) is arranged for holding specific attributes or characteristics of those objects included in the SuM-GI Data Model in a generic information placeholder associated to each particular object. Thus, additional advantages may be obtained from arranging said Subscription Management Generic Interface (SuM-GI) for allowing each individual SuM-GI Agent to determine whether or not each particular attribute in a list of attributes is applicable in the node where the SuM-GI Agent resides, the applicability depending on a specific internal data model in said node.

[0045] Nowadays a foreseeable use of said Subscription Management Generic Interface (SuM-GI) is proposed for operating in accordance with an Integration Reference Point (IRP) specification within an IRP Generic Network Resource Model. To this end, the SuM-GI further comprises any Managed Object Class, or combinations thereof, selected from a group of Object Classes that includes:

- SubscriptionIRP object class, intended for indicating to a SuM-GI Manager the SuM-GI version supported by each particular SuM-GI Agent in a Managed Entity, and thus arranged for comprising a list of the SuM-GI versions supported by known SuM-GI Agents;

- SubscriptionFunction object class, intended for sub-classing Subscription, Subscriber, User, and UserServicePreferences related object classes and arranged for providing attributes that are common to underlying Managed Object Classes; and

- ServiceProviderFunction object class, intended for sub-classing ProvidedService related object classes and arranged for providing attributes that are common to underlying Managed Object Classes.

BRIEF DESCRIPTION OF DRAWINGS

[0046] The features, objects and advantages of the invention will become apparent by reading this description in conjunction with the accompanying drawings, in which:

[0047] **FIG. 1** represents a block diagram showing a basic architecture comprising a Provisioning Node responsible for issuing provisioning orders and a number of Provisioned Nodes where service subscriptions are provisioned.

[0048] **FIG. 2** represents a block diagram showing a generic architecture including one entity of a hierarchical Sub-Network Manager structure interposed between a Manager entity and a number of Provisioned Nodes.

[0049] **FIG. 3** shows a Generic Network Resource Model (NRM) Containment/Naming and Association diagram as included in 3GPP TS 32.622 V4.2.0 (2002-03).

[0050] FIG. 4 presents a resource model with Object Classes included in a Subscription Management Generic Interface (SuM-GI) Data Model in accordance with an aspect of the present invention.

[0051] FIG. 5 shows a use of the resource model in Fig. 4 integrated with the Generic Network Resource Model (NRM) shown in Fig. 3 in accordance with an aspect of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0052] The following describes the currently preferred embodiments of means, method and system intended for providing a Generic Interface for Subscription Management.

[0053] In accordance with one aspect of the present invention, there is provided a solution for service provisioning that is generic and fits any domain, whether telecom, internet, or any service-related domain. This solution can be used in any scenario wherein a management entity is provisioning a given service in a managed entity, allowing potential users of a service to be subscribed to, to provide user preferences or settings for, and to be withdrawn from said service. In this context, the management entity may be regarded as an entity in a network provisioning a service, thus hereinafter referred to as a Provisioning Node, whereas the managed entity may be regarded as an entity in a network where a service is provisioned, and thus hereinafter referred to as a Provisioned Node.

[0054] Such solution is achieved within the present invention thanks to a Subscription Management Generic Interface (hereinafter abbreviated as SuM-GI) that is intended for enabling the exchange of information related

to provisioning activities between a Provisioning Node and a number of Provisioned Nodes. This Provisioning Node is, generally speaking, the entity in charge of issuing the orders needed to establish a subscription, whereas the Provisioned Node is the entity that contains the subscription related data.

[0055] Therefore, the SuM-GI is arranged for modelling the information related to those resources to be managed and the way in which such information may be accessed and manipulated. Such modelling is done in a way that is independent of the technology and distribution used in the implementation of a management system. Thus, the SuM-GI avoids the dependency on both, the technology of the communication protocol used, and the specific service data being provisioned.

[0056] A basic architecture supporting the SuM-GI is shown in Fig. 1 wherein a Provisioning Node (300) acts on two different Provisioned Nodes (100, 200). The Provisioning Node (300) comprises a SuM-GI Manager (310) and a number of Protocol Adapters (301, 302, 303) for communicating with each Provisioned Node (100, 200) with an appropriate protocol technology (P-01, P-02). Each Provisioned Node (100, 200) comprises a particular SuM-GI Agent (110, 210) operating in accordance with the protocol technology (P-01, P-02) for communicating with the respective Provisioned Node (100, 200).

[0057] The Provisioning Node is in charge of submitting subscription related orders towards a number of Provisioned Nodes, each of them with its own data model and provisioning technology. Relevant Provisioned Nodes (100, 200) receive these subscription related orders (P-01, P-02) sent by the Provisioning Node (300). In accordance with a preferred embodiment, the SuM-GI Agent (110, 210) receives

such orders, interprets them, and executes the corresponding actions in the Provisioned Node.

[0058] An advantageous flexibility can be obtained from supporting a number of Protocol Adapters (301, 302, 303) for enabling communications from the SuM-GI Manager towards Provisioned Nodes implementing particular SuM-GI Agents based on vendor-specific protocol technology such as CORBA, LDAP, or others such as Simple Object Access Protocol (SOAP), for example. In this respect, any supplier of a Provisioned Node can freely decide what protocol technology better fits its own internal requirements whereas this choice does not negatively impact on the implementation of the Provisioning node. One fundamental principle for achieving this is to clearly separate the semantic of information definition from the protocols definitions for the external interfaces. If a Provisioning Node needs to speak with a particular Provisioned Node that uses a new technology, a corresponding new technology Protocol Adapter should be incorporated at the Provisioning Node.

[0059] Thus, thanks to the Subscription Management Generic Interface (SuM-GI), and more specifically to the generic data model and operations included therein, a Provisioning Node does not need know the details of each particular data model of the different Provisioned Nodes. Further, each Provisioned Node is responsible for mapping a generic data model to its own internal data model in accordance with one aspect of the present invention. Therefore, each Provisioned Node (100, 200) includes a Mapping Module (120, 220). Each particular Mapping Module is in charge of mapping instances of the generic data model received (P-01, P-02) from the Provisioning Node to an internal data model (130, 230) respectively included in each Provisioned Node.

[0060] For example, a Provisioning Node (300) wants to create a subscription in a Home Location Register (HLR) of a mobile network, the HLR then being a Provisioned Node for the purpose of the present invention. This exemplary HLR (200) uses CORBA technology for provisioning purposes. The Provisioning Node (300) through the SuM-GI Manager (310) sends a "create_subscription" order towards the HLR via a CORBA Adapter (302). Such "create_subscription" order is defined through the Subscription Management Generic Interface (SuM-GI) as an Operation over a Managed Object Class called "subscription" in a SuM-GI Data Model that the present invention provides.

[0061] Different alternatives are suitable in this example for a SuM-GI Manager to know the protocol technology used by each Provisioned Node. In accordance with a currently preferred embodiment of the present invention, the HLR registers itself as a SuM-GI Agent at the SuM-GI Manager indicating the use of CORBA. In accordance with another embodiment of the present invention, configuration means at each particular Provisioning and Provisioned nodes might also be appropriate for establishing at the SuM-GI Manager the different protocol technologies used by the different Provisioned Nodes.

[0062] The "create_subscription" order is received at the HLR via its SuM-GI CORBA Agent (210), which is waiting for subscription related orders. This SuM-GI CORBA Agent (210) receives such order interpreting that actions to create a subscription have to be carried out. At this stage, the SuM-GI CORBA Agent must determine over which Managed Object Classes of the HLR the agent has to operate. Therefore, the SuM-GI CORBA Agent consults the Mapping Module (220) which in turn searches the internal data model (230) at the HLR to identify the particular Managed Object Class, or the

specific object, to operate on. Then, the SuM-GI CORBA Agent is enabled to perform the actions required to initiate the subscription.

[0063] This simple architectural model shown in Fig. 1, wherein a Provisioning Node is directly connected to a number of Provisioned Nodes, may be adapted to other network topologies where another hierarchical network composition is already established. An exemplary embodiment is presented in Fig. 2 showing an applicability of the present invention for a network management architecture following current 3GPP trends. This network management architecture comprises a Network Manager (NM) (300) that provides a package of end-user functions for management of a network and may also involve direct access to Network Elements, a Sub-Network Manager (SNM) (400) that includes functions related to a network model for a set of Network Elements constituting a clearly defined sub-network, and a number of Network Elements (NE) (100, 200) to be managed.

[0064] The Network Manager (300) in the topology presented in Fig. 2 behaves as a pure Provisioning Node in accordance with an aspect of the present invention already described. This NM (300) thus includes a SuM-GI Manager (310) and a number of Protocol Adapters (302) for communication with a following hierarchy of managed nodes, which in this network topology correspond to at least one level of Sub-Network Managers (400). Each SNM (400) behaves as a Provisioned Node in respect of the NM (300) and as a Provisioning Node towards a following hierarchy of managed nodes, the latter being Network Elements (100, 200) in Fig. 2 acting as pure Provisioned Nodes.

[0065] A Sub-Network Manager (400), which in Fig. 2 is hierarchically located between a pure Provisioning Node (300) and a number of pure Provisioned Nodes (100, 200),

thus presents a Provisioned Node side towards the Network Manager (300), and a Provisioning Node side towards the Network Elements (100, 200) to be managed. Therefore, each SNM (400) comprises a number of Protocol Adapters (302) and a SuM-GI Agent (410) for communication with the Network Manager, that is the Provisioned Node side in this SNM. Each SNM (400) further comprises another number of Protocol Adapters (302) and a SuM-GI Manager (310) for communication in Fig. 2 with a Network Element 1 (100) and with a Network Element 2 (200), that is the Provisioning Node side in this SNM.

[0066] Each NE (100, 200) includes a SuM-GI Agent (110, 210) based on a particular vendor-specific protocol technology, each SuM-GI Agent for communication with a SuM-GI Manager at a Provisioning Node side. Each NE (100, 200) also includes a Mapping Module (120, 220) for mapping instances of a generic data model received (P-01, P-02) from a Provisioning Node side to an internal data model (130, 230) respectively included in each Provisioned Node. In another embodiment of the present invention, not illustrated in the current drawings, there is provided a general purpose SuM-GI Agent with a specific Protocol Adapter, thus acting in a similar manner as for the SuM-GI Manager.

[0067] A sort of management entity like a Sub-Network Manager presenting a Provisioned Node side towards a Provisioning Node, and a Provisioning Node side towards a number of Provisioned Nodes allows to build up a Management system with a hierarchy of multiple management levels. This hierarchical Management system thus comprises a pure Provisioning Node at the highest level, namely a Network Manager (300) with a Provisioning Node side; a number of hierarchically disposed Sub-Network Managers (400), each

one with a Provisioned Node side and with a Provisioning Node side; and a number of pure Provisioned Nodes at the lowest level, namely Network Elements (100, 200) with a Provisioned Node side.

[0068] The aforementioned generic data model included in the Subscription Management Generic Interface, hereinafter referred to as SuM-GI Data Model, specifies a basic set of Object Classes that, along with a basic set of Operations on said Object Classes, can describe a generic provisioning mechanism in accordance with an aspect of the present invention. This basic model, however, is powerful enough to permit all the transactions related to subscription management to be accomplished.

[0069] In this respect, a basic set of Object Classes defined in the SuM-GI Data Model is shown in Fig. 4 and comprises: a Subscription class, a UserServicePreferences class, a Subscriber class, a User class and a ProvidedService class.

[0070] The Subscription is a central Object Class in the SuM-GI Data Model, and is intended for modeling the agreement or contract established between a subscriber and a service provider. The Subscription class contains all the information related to the subscription, such as identifiers of subscribed services, subscriber identifiers, subscriber preferences, etc. The Subscription class represents a temporal relation between a subscriber and a service provider regarding an offered service, namely a relation between a ProvidedService class and a Subscriber class. A subscriber can have more than one subscription for different services.

[0071] The UserServicePreferences class is intended for allowing that a number of users associated with a given

subscriber may have their particular service preferences. In other words, particular instances of this object class offer the possibility to have different capabilities enabled for each user. This object class holds a preference matrix formed between users and service capabilities.

[0072] A User class is thus related with a Subscription class through the UserServicePreferences class. A user can be associated with more than one subscription, and a subscription can have more than one user declared. The service preferences for a subscriber are kept in the Subscription class, whilst the service preferences for a user are kept in the UserServicePreferences class.

[0073] The Subscription Management Generic Interface is arranged for holding specific attributes or characteristics of those Object Classes included in the SuM-GI Data Model in a generic information placeholder associated with each particular object, for example in a list of attributes holding name-value pairs. Each individual SuM-GI Agent is responsible for determining whether or not each particular attribute in the list of attributes is applicable in the node where the SuM-GI Agent resides. The applicability in a node of a certain attribute for a given Object Class included in the SuM-GI Data Model, as determined by the SuM-GI Agent in the node, depends on the specific internal data model in said node.

[0074] This is an advantageous feature provided by the present invention since the SuM-GI Agent (110, 210, 410) can describe its own data model by mapping its internal object classes to those object classes included in the SuM-GI Data Model, so that the SuM-GI Manager (310) does not need be changed each time a new agent is introduced into the management system. Moreover, the SuM-GI Agent is free to define any attributes needed for the existing object

classes in the SuM-GI Data Model, and is also free to set and handle as many instances of said object classes, as the SuM-GI Agent is able to.

[0075] Apart from the above SuM-GI Data Model, the Subscription Management Generic Interface (SuM-GI) also includes a set of basic Operations for allowing the establishment and administration of all the relationships between the Object Classes defined in said SuM-GI Data Model.

[0076] Thereby, a communication system supporting the above SuM-GI is enabled to operate on the Subscription class, the ProvidedService class, the Subscriber class, the User class, and on the UserServicePreferences class during the process of creation, retrieval, modification, deletion, activation and deactivation of the corresponding class settings.

[0077] In addition, the SuM-GI Data Model may be represented in terms of object classes and associations following the 3GPP TS 32.622 wherein an "Aggregation by Reference", hollow diamonds following the UML notation, is normally used. As shown in the existing IRP model (Object Model III) shown in Fig. 3, the associations allow the navigability from an associating class to a target class. Navigability is indicated by an open arrow placed on the target end of the association line next to the target class. An association can be unidirectional, namely an arrow in the end next to the target class, or bi-directional, namely without arrows.

[0078] The above SuM-GI Data Model following the UML notation (Object Model II) is thus represented in Fig. 4 by its basic set of object classes and relations between them. As shown in Fig. 4, a ProvidedService (C-21) object class

is related to a target class Subscription (C-22) with an association "IsSubscribed" whereas a Subscriber (C-23) object class is related to the same target class Subscription (C-22) with an association "Has". The object class Subscriber (C-23) is related to a target class User (C-25) with an association "Registers" that allows having more than one user registered for the same subscriber. A recursive association (S-25) within the User (C-25) object class allows the establishment of hierarchies of users or groups of users. The object class User (C-25) is related to a target class UserServicePreferences (C-24) with an association "Has" whereas the UserServicePreferences (C-24) is also a target class for the object class Subscription (C-22) from which there is an association "Contains".

[0079] Further, in order to accomplish the integration of a Subscription Management IRP with the three currently existing O&M areas under "3GPP TS 32.622 v4.2.0 Generic Network Resources IRP: Network Resource Model (Release 4)" (Object Model III) shown in Fig. 3, there are provided three new object classes within the SuM-GI Data Model: a SubscriptionIRP Object Class (C-28) and two new Managed Objects Classes (C-26, C-27). The SubscriptionIRP Object Class (C-28), as any other existing object class aggregated to the Managed Object Class IRPAgent, indicates the capabilities associated with each particular IRPAgent object. In other words, each particular instance of the SubscriptionIRP Object Class (C-28) comprises a list of the IRP versions supported by the IRPAgent. The two new Managed Objects Classes (C-26, C-27), SubscriptionFunction and ServiceProviderFunction, are provided for sub-classing only. Each of these Managed Object Class provides the attributes that are common to certain functional Object Classes, and may be extended in the future if more common

characteristics or attributes of functional objects are identified.

[0080] As shown in Fig. 5, the integration of a Subscription Management IRP with the three currently existing O&M areas IRP for 3GPP is achieved by aggregating the above new SubscriptionIRP object class to the IRPAgent object class, this SubscriptionIRP being thus associated to the three Managed Object Class (MOC): ManagementNode, SubNetwork and ManagedElement. In particular, said MOC ManagedElement represents telecommunication equipment or telecommunication management network entities that perform Network Element related functions. Consequently, network nodes making use of the above SubscriptionIRP may be included in this category. Therefore, in accordance with a currently preferred embodiment of the present invention, both SubscriptionFunction and ServiceProviderFunction inherit from the ManagedElement in a manner such that all the managed objects defined in the SubscriptionIRP can be managed by other existing IRPAgents, namely Alarm, Configuration and Notification.

[0081] After having described the object classes and associations in the SuM-GI Data Model, the SuM-GI Operations are described following this in order to complete a description of a Subscription Management Generic Interface (SuM-GI) in accordance with currently preferred embodiments of the present invention.

[0082] The SuM-GI Operations may be classified depending on the particular object class firstly instanced from the above SubscriptionFunction and ServiceProviderFunction, respectively, which are Subscription (C-22), Subscriber (C-23) and User (C-25) on the one hand, and ProvidedService (C-21) on the other hand. The format indicated for these

SuM-GI Operations is merely illustrative and wherein input data are given between brackets and output data follow ":".

(a) Subscription related SuM-GI Operations:

(a1) *createSubscription (subscriberID, serviceID, attributeListIn, ...): subscriptionID, attributeListOut;*

This operation creates a subscription and just shows some necessary parameters wherein the *attributeListIn* comprises subscription data and subscriber preferences for the indicated service. The operation returns an identifier for the created subscription, *subscriptionID*, and other relevant information in the *attributeListOut*.

(a2) *modifySubscription (subscriptionID, attributeListIn, ...): attributeListOut;*

This operation modifies the attributes of the subscription, more specifically the subscription data and the service subscriber preferences. By using this operation a subscriber can modify the selection, activation, configuration, or deactivation of capabilities offered for a given subscribed service. For example, if a Health care service is the subscribed service, a Dental service is an option within the Health care service that can be chosen, or not chosen, in the subscription. In particular, *attributeListOut* may indicate detailed reasons of failure.

(a3) *removeSubscription (subscriptionID, ...);*

This operation ends a particular subscription.

(a4) *getSubscription (filter, attributeListIn ...): subscriptionID_list, attributeListOut;*

This operation returns a list of subscriptions, each one with respective identifier and optionally a corresponding list of attribute values associated with each subscription, *attributeListOut*, which are requested in *attributeListIn*. The *filter*, which is used as search criteria for selecting specific subscriptions, can be composed by pairs of attributes and values related to the subscription as part of assertions that may be grouped using logical operators such as "AND" or "OR".

(a5) *addServiceUser (subscriptionID, userID, attributeListIn, ...);*

This operation is used to register a new user in a subscription, thus allowing him to use the service subscribed. The *attributeListIn* are the attributes of the subscribed service, and some of these attributes may be configured for said user. User preferences can be configured when the user is added or later with the operation *setUserServicePreferences*. Depending on service provider policy, if user service preferences are not set with this operation, the subscriber preferences set when creating the subscription apply until new user service preferences are set with the operation *setUserServicePreferences*.

(a6) *removeServiceUser (subscriptionID, userID, ...);*

This operation is used to withdraw a user from a subscription.

(a7) *getServiceUser (subscriptionID,...): userID_list;*

This operation returns the users registered in a certain subscription.

(a8) *setUserServicePreferences (subscriptionID, userID, userPreferences, ...);*

This operation configures all attributes of a service customised for a user. The operation also enables or disables capabilities of a subscribed service for a particular user.

(a9) *getUserServicePreferences (subscriptionID, userID, ...): userPreferences;*

This operation returns a list of service preferences for a particular user in a given subscription. The service preferences may include the capabilities or features offered by the subscribed service and that are configured for this user.

(b) Subscriber related SuM-GI Operations:

(b1) *createSubscriber (attributeListIn, ...): subscriberID;*

This operation is used to create a subscriber.

(b2) *modifySubscriber (subscriberID, attributeListIn,...): attributeListOut;*

This operation modifies subscriber service independent data included in the *attributeListIn*. In particular, *attributeListOut* may indicate detailed reasons of failure.

(b3) *removeSubscriber (subscriberID, ...);*

This operation is used to withdraw a subscriber.

(b4) *getSubscriber (filter, attributeListIn, ...): subscriberID_list, attributeListOut;*

This operation returns a list of subscribers with certain characteristics defined in the *filter*, and a list of attribute values, *attributeListOut*, which are requested in *attributeListIn*.

(c) User related SuM-GI Operations:

(c1) *createUser (attributeListIn, ...): userID;*

This operation is used to create a user.

(c2) *modifyUser (userID, attributeListIn,...): attributeListOut;*

This operation modifies user service independent data included in the *attributeListIn*. In particular, *attributeListOut* may indicate detailed reasons of failure.

(c3) *removeUser (userID, ...);*

This operation is used to withdraw a user.

(c4) *getUser (filter, attributeListIn, ...): userID_list, attributeListOut;*

This operation returns a list of users with certain characteristics defined in the *filter*, and a list of attribute values, *attributeListOut*, which are requested in *attributeListIn*.

(d) ProvidedService related SuM-GI Operations:

(d1) *createService (attributeListIn, ...): serviceID;*

This operation is used to create a service. A given service can contain other services as capabilities of said given service. Those services included in a said given service are included in the above *attributeListIn* parameter.

(d2) *modifyService (serviceID, attributeListIn, ...): attributeListOut;*

This operation modifies capabilities of a given service, which are included in *attributeListIn*. In particular, *attributeListOut* may indicate detailed reasons of a failure.

(d3) *removeService (serviceID, ...);*

This operation is used to withdraw a service.

(d4) *getService (filter, attributeListIn, ...): attributeListOut;*

This operation returns information about one or several services with certain characteristics defined in the *filter*. A list of attributes values per service, ordered in *attributeListIn*, is returned in *attributeListOut* containing parameters related with a service, such as read/write or read-only for example. Some of these attributes are optional capabilities or parameters that can be set in the subscription, whereas others can be refined for a particular user with a *setUserServicePreferences* operation.

[0083] The above SuM-GI Operations are proposed in accordance with an aspect of the present invention assuming

that particular objects of the object class User are directly instanced from the functional object class SubscriptionFunction so that the same instance of a certain user can be shared by more than one subscription. There may be, however, other preferred embodiments wherein a particular object of the object class User is instanced through a particular relationship like Registers from the object class Subscriber. This way, the same instance of a certain user is not shared by more than one subscription. These alternative embodiments, which are not exclusive to each other, do not negatively affect the particular internal data model held at any managed node inasmuch as flexible and coherent mapping modules are provided as well.

[0084] The invention is described above in respect of several embodiments in an illustrative and non-restrictive manner. Obviously, many modifications and variations of the present invention are possible in light of the above teachings. The scope of the invention is determined by the claims, and any modification of the embodiments that fall within the scope of these claims is intended to be included therein.